IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.:	10/780,025
FILING DATE:	FEBRUARY 17, 2004
APPLICANT:	GU, WENBIN ET AL.
GROUP ART UNIT:	1745
EXAMINER:	WALKER, KEITH D.
TITLE:	CAPILLARY LAYER ON FLOWFIELD FOR WATER MANAGEMENT IN PEM FUEL CELL
ATTORNEY DOCKET:	8540G-000187 (GP-303100)

REPLY BRIEF

MS Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

This is a reply brief responding to an Examiner's Answer mailed July 11, 2007. Appellants filed an appeal brief on February 28, 2007. In the Examiner's Answer, the Examiner cited new grounds of rejection, thus, this Reply Brief is due on September 11, 2007, as required under 37 C.F.R. § 41.39(b)(2), within two-months from the date of the Examiner's Answer.

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I. Real Party In Interest

The real party in interest is General Motors Corporation. An assignment from the inventors to assignee, General Motors Corporation, was executed on February 4 and 5, 2004 and recorded with the U.S. Patent and Trademark Office at Reel/Frame No. 014993/0825.

II. Related Appeals, Interferences, And Judicial Proceedings

There are no other appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. Status Of Claims

Claims 1-3, 5-12, and 15-23 are finally rejected. Claims 24-29 and 31-50 were withdrawn from consideration. Claims 4 and 30 have been cancelled. The claims on appeal are Claims 1-3, 5-12, and 15-23.

IV. Status Of Amendments

Applicants filed an Amendment After Final Rejection on October 24, 2006 pursuant to 37 CFR §1.116 amending Claim 1 and cancelling Claim 3. These amendments were not entered.

V. Summary Of Claimed Subject Matter

The rejected claims include one independent claim (Claim 1).

Claim 1

Independent Claim 1 recites an electrochemical cell having a membrane electrode assembly (MEA) with an anode and a cathode. Figures 1, 2; Page 1, lines 12-14; page 2, lines 8-10; page 9, lines 10-12. The cell comprises a porous liquid distribution media that is disposed along a major surface of an impermeable electrically conductive element. Page 14, lines 12-15. The liquid distribution media is electrically conductive. Figures 2, 3; Page 19, lines 19-20; page 20, lines 1-4. Further, the liquid distribution media defines flow channels to transport gas and liquid to and from the cathode. Figures 2, 3, 8, 9; Page 2, lines 11-14; page 14, lines 15-19; page 15, lines 11-19; page 16, lines 1-2.

The cell also comprises a fluid distribution layer, which is disposed between the liquid distribution media and the cathode. Figures 2, 8, 9; Page 2, lines 14-17; page 10, lines 12-16, page 11, lines 1-2. The fluid distribution layer transports fluids and liquids between the cathode and flow channels of the liquid distribution media. Figures 2, 8, 9; Page 10, lines 4-14; page 20, lines 9-18. The fluid distribution layer is also porous and has an average pore size that is larger than an average pore size of the porous liquid distribution media. Page 20, lines 19-22.

The liquid distribution media wicks and distributes liquids generated at the cathode and transported through the fluid distribution layer, which maintains uniform water distribution and humidity across the entire surface of the MEA to improve cell performance, durability and longevity. See Page 14, line 15 to page 16, line 2; page 33, line 22 to page 34, line 2. The liquid distribution media also reduces mass transfer resistance by effectively separating gas and liquid transport paths. Page 14, line 15 to page 16, line 2. Thus, the invention of Claim 1 provides a self-regulated water management system, where water is internally distributed within the liquid distribution media and vaporized or entrained by gases passing over the liquid distribution media. Page 33, lines 12-15. The claimed features provide enhanced water removal, reduced potential for electrode flooding, and increased mass transport to regions of lower liquid concentration to promote higher fuel cell operational efficiency and lower electrical resistance loss. Page 33, lines 16-22. Claims 2-3, 5-12, and 15-23 depend on Claim 1.

<u>Claim 3</u>

Claim 3 further defines over the cited art. In Claim 3, the liquid distribution media forms an electrically conductive path between the impermeable electrically conductive element and the conductive fluid distribution layer. Figures 2, 8, 9 and 10; Page 23, lines 18-21.

Claim 6

Claim 6 further defines over the cited art. Claim 6 provides a liquid distribution media that overlies substantially all of the major surface of the electrically conductive impermeable substrate. Figures 2, 3, 8 and 9; Page 21, lines 19-22.

Claim 8

Claim 8 also further defines over the cited art. Claim 8 recites that the liquid distribution media forms an undulated configuration of peaks (lands) and valleys (grooves). Figure 8; Page 23, lines 16-18.

Claim 12

Claim 12 further defines over the cited art and recites a liquid distribution layer that comprises two distinct layers. Figure 9; Page 24, lines 2-6.

Claim 22

Claim 22 is separately rejected because it recites an impermeable electrically conductive element that comprises a compound selected from the group consisting of: aluminum, titanium, stainless steel, and alloys and mixtures thereof. Page 13, lines 18-19.

VI. Grounds Of Rejection To Be Reviewed On Appeal

1. Claims 1-3, 5-12, 15-21 and 23 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Miyazawa (U.S. Pat. Pub. No. 2003/0235735) in view of Yamada (U.S. Pat. No. 5,432,023).

2. Claim 22 stands rejected under 35 U.S.C. § 103(a) over Miyazawa (U.S. Pat. Pub. No. 2003/0235735) in view of Yamada (U.S. Pat. No. 5,432,023) and Davis (U.S. Pat. Pub. No. 2002/0001743).

VII. Argument

A. The Examiner's Answer Raised New Grounds of Rejection Which Still Fails to Establish a *Prima Facie* Case of Obviousness of the Rejected Claims.

In the Examiner's Answer of July 11, 2007, the Examiner indicated a new ground for rejection. Accordingly, this Reply Brief is being submitted to address the Examiner's new rejections and arguments. The Examiner's Answer does not clearly indicate the basis of the new grounds for rejection, but rather generally refers to Section (9). Examiner's Answer, Page 13, 5th Paragraph. Based on Appellants' comparison of Section (9) of the Examiner's Answer to the Final Office Action of August 24, 2006, it appears that the Examiner has elaborated on the rationale underlying the rejection of dependent Claim 12 over the same cited references. *See* Examiner's Answer, Page 5, 3rd Paragraph bridging Page 6, 2nd Paragraph. It does not appear that any other new ground of rejection has been raised. Appellants maintain that the rejections over the cited art remain deficient and should be reversed, for the further reasons set forth in the Appeal Brief filed on February 28, 2007, which are incorporated herein in their entirety, and for the reasons contained in this Reply Brief, where the Examiner's new ground of rejection and newly presented arguments are addressed.

B. Claims 1-3, 5-12, and 15-23 Are Not Rendered Obvious by Miyazawa and Yamada Because Yamada Teaches Away From Such a Combination.

As referred to herein, the cited references are Miyazawa (U.S. Pat. Pub. No. 2003/0235735) referred to as "Miyazawa," Yamada (U.S. Pat. No. 5,432,023) referred to as "Yamada," and Davis (U.S. Pat. Pub. No. 2002/0001743) referred to as "Davis." The general basis for the rejections of Claims 1-3, 5-12, and 15-23 remains the same, as addressed in

Appellants' Appeal Brief. However, the Examiner clarifies the rationale for the rejections and presented new arguments, which will be addressed herein.

The Examiner's Answer in Section 10 states that the Yamada reference is solely used "to teach the size of the pores of the two layers," and that Appellants' arguments that Yamada teaches away from the proposed modification, because Yamada would be inoperable for its intended purpose with such a modification, are allegedly inapposite. Yet, selectively picking certain aspects of the prior art, while ignoring other aspects of the teachings of the same prior art, fundamentally defies an obviousness inquiry and is verboten.

"It is impermissible within the framework of section 103 to pick and choose from any one reference only so much of it as will support a given position to the exclusion of other parts necessary to the full appreciation of what such reference fairly suggests to one skilled in the art." *Bausch & Lomb, Inc. v. Barnes-Hind/Hydrocurve, Inc.*, 796 F.2d 443, 448, 230 USPQ 416, 419 (Fed. Cir. 1986) *citing In re Wesslau*, 353 F.2d 238, 241, 147 USPQ 391, 393 (CCPA 1965) and *In re Mercier*, 515 F.2d 1161, 1165-66, 185 USPQ 774, 778 (CCPA 1975)("The board's approach amounts, in substance to nothing more than a hindsight 'reconstruction' of the claimed invention by relying on isolated teachings of the prior art without considering the over-all context within which those teachings are presented. Without the benefit of appellant's disclosure, a person having ordinary skill in the art would not know what portions of the disclosure of the reference to consider and what portions to disregard as irrelevant, or misleading.") In other words, a prior art reference must be considered in its entirety, including those portions which may refute obviousness by teaching away from the claims. *See e.g., W. L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1550, 220 USPQ 303, 311 (Fed. Cir. 1983) and Manual of Patent Examining Procedure §2141.03(VI)(Rev. 5, Aug. 2006). Thus, the Examiner's statements to only view Yamada for a select portion of its teachings is improper.

Obviousness first requires a determination of the scope and content of the prior art; second, a comparison of the differences between the prior art and the claims; third, a determination of the ordinary skill in the pertinent art; and finally any objective evidence of non-obviousness. *See KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1730-31 (2007) *citing Graham v. John Deere Co. of Kansas City*, 383 U.S. 1 (1966). "Against this background the obviousness or nonobviousness of the subject matter is determined." *KSR*, 127 S.Ct. at 1730.

The scope and content of the Miyazawa and Yamada references are briefly reiterated here to address the new arguments raised by the Examiner. The Miyazawa reference provides a porous fuel cell separator element that uses porous ribs to establish electrical connection with electrodes of a membrane electrode assembly (MEA). Miyazawa, Paragraphs [0028] and [0033]. Miyazawa also teaches forming such a separator element 4 by applying a hydrophilic membrane 14, however Miyazawa requires membrane 14 to be removed from the top surface 23 of the ribs 11 prior to use in the fuel cell. Paragraphs [0033], [0040], and [0042]. Thus, Miyazawa only provides a hydrophilic membrane 14 on the side 12 and bottom walls 13 of the flow channel grooves 7. The underlying objective of Miyazawa is to provide a hydrophilic membrane 14 in fluid contact with the porous rib 11 to melt frozen water during start-up for cold operating conditions. Paragraphs [0029], [0033]. While the hydrophilic membrane coating 14 includes a material with hydrophilic and electrically conductive materials, Miyazawa does not teach or suggest that the entire hydrophilic membrane is disposed in an electrical path formed between the electrodes (3*a*,3*b*) and the separator 4. Paragraph [0036]. ("Since the top face 23 of the rib contacting to the MEA is not provided with a hydrophilic membrane 14, it is possible to avoid reductions in porosity in the section connecting the separator 4 with the electrode (3a, 3b)." *Emphasis added*, Miyazawa, Paragraph [0033]. Nor does Miyazawa suggest providing an overall hydrophilic membrane 14 (as opposed to one of several materials contained in the coating) having sufficient electrical conductivity to be employed within an active area of a fuel cell as an electroconductive element establishing an electrically conductive path.

The teachings of Yamada relate to liquid-fuel fuel cells having electrodes. *See e.g.*, Col. 1, lines 27-29. Yamada includes a water recovery system outside of the fuel cell, where an electrode contacts a first wicking material to draw water from the fuel cell. Col. 10, lines 1-6; Col. 38, lines 4-11. The external water-recovering wicking material is placed into a water-recovering channel 35 connected to a water storage vessel downstream 41. Col. 38, lines 4-10, 15-18, 30-35. The water storage vessel 41 includes a second wicking material having a smaller pore size to draw water from the first wicking material into the storage vessel. Col. 38, lines 22-27. The teachings of Yamada state that electrically conductive porous wicking materials should be avoided to prevent short-circuiting. Col. 47, lines 10-15, Col. 38, lines 8-9, 67-68, and Col. 39, lines 21-25. Thus, Yamada provides a fuel cell having a water-conducting conduit using

electrically nonconductive porous materials to wick the water away from the fuel cell to a water-storage receptacle.

In the second aspect of the *Graham* obviousness inquiry, the question of obviousness evaluates any differences between the claimed invention and the prior art. It is the claimed invention as a whole which is assessed for obviousness. *See Bausch & Lomb,* 230 USPQ at 419 (Fed. Cir. 1986). The invention set forth in independent Claim 1, recites a fuel cell having a fluid distribution layer (FDL) disposed between an electrically conductive and porous liquid distribution media (LDM) and a cathode. The electroconductive separator element is impermeable in Claim 1. The LDM and the FDL are distinct layers that significantly enhance water management by providing separation of vapors, gases, and liquids in the active flow field. Further, the LDM has sufficient electrical conductivity for placement between an impermeable electrically conductive element (*e.g.*, a separator) and the FDL during fuel cell operation. Moreover, Claim 1 recites that the FDL has an average pore size that is larger than an average pore size of the porous LDM, which enhances separation of liquids from vapors/gases within the flow field. A cell having an LDM, such as that of Claim 1, maintains electrical conductivity while providing various beneficial advantages, including wicking and transporting liquids generated at the cathode, maintaining uniform water distribution and humidity across the MEA to improve cell performance, as well as providing reduced mass transfer resistance by separating gas and liquid transport paths in the flow fields at the cathode. Appellants' specification at page 14, lines 15 to page 16, line 2.

Miyazawa does not describe or suggest that the FDL has an average pore size that is larger than that of the LDM, contrary to the allegatons in the Non-Final Office Action dated March 13, 2006 on Page 4, lines 18-19. The Examiner may cite Yamada to provide that the pore sizes of wicking materials are decreased in the direction of water flow, but Yamada specifies that such porous materials are not electrically conductive and thus are not suitable for use in an active flow field to transport both gases and liquids inside a fuel cell. If Yamada is considered in its entirety, it explicitly teaches away from electrically conductive wicking materials, that Appellants claim. When the prior art teaches away from combining certain known elements, discovery of a successful means of combining them can support the nonobviousness of the claimed invention. *See KSR Int'l Co. v. Teleflex Inc.,* 127 S.Ct. 1727, 1730-31 (2007) *citing United States v. Adams,* 383 U.S. 39, 40, 86 S.Ct. 708, 15 L.Ed.2d 572 (1966). Yamada advises

against selecting conductive materials as the wicking material to prevent short circuiting (reinforcing that the wicking materials are exterior to the active fuel cell area). Col. 47, lines 10-15; Col. 38, lines 8-9 and 67-68; and Col. 39, lines 21-25. As such, Yamada teachings support the non-obviousness of the claimed invention rather than an obviousness rejection.

In the third aspect of the *Graham* obviousness inquiry, one of skill in the art, when viewing Miyazawa and Yamada in their respective entireties, would fail to find any apparent reason to arrive at the claimed invention. Miyazawa provides a separator with a hydrophilic membrane that is removed from electrical contact regions. The hydrophilic membrane of Miyazawa is only present in non-contact regions (*i.e.*, the grooves) for melting frozen water. Yamada provides a liquid-fuel based fuel cell having an external water wicking system. Furthermore, Yamada teaches one of skill in the art that only electrically non-conductive wicking materials are suitable, otherwise Yamada would be rendered inoperable, because it would cause the fuel cell to short circuit. Thus, one of skill in the art would not look to combine the coatings inside the channels provided by Miyazawa with the non-conductive porous liquid wicking materials in Yamada for use as an electrically conductive element inside an electrically conductive active field to arrive at the claimed invention. Aside from impermissible hindsight garnered from Appellants' specification, there is no apparent reason for one of skill in the art to combine Miyazawa with Yamada to arrive at the claimed impermeable separator element having two electrically conductive porous elements (GDL and LDM) with different respective porosities, disposed between an electrode of an MEA and the electrical contact regions of the impermeable electroconductive element to separate liquids and gases for improved water management during fuel cell operation, without detrimentally affecting fuel cell electrical performance.

i) <u>Claim 3 is Separately Patentable Over Miyazawa and Yamada Because the Combination Does Not Suggest Forming an Electrically Conductive Path Through the Liquid Distribution Media as Recited in Claim 3.</u>

In addition to the reasons set forth above for Claim 1, and in the Appeal Brief, none of the cited references describes or suggests forming an electrically conductive path through an electrically conductive porous LDM, which is disposed between an electrically conductive element and a conductive fluid distribution layer (FDL), as recited in dependent Claim 3.

The Examiner states that Miyazawa has a hydrophilic layer that is removed from the very top surface of the separator's protrusions so that the hydrophilic layer is left on the sidewalls and bottom surface of the separator (Fig. 2). Section 10(B), Examiner's Answer, Page 11. However, nowhere does Miyazawa teach that an electrically conductive path is established from the hydrophilic layer 14 to the gas diffusion layer 21. For example, at Paragraphs [0039]-[0040], Miyazawa states that the channels are filled with a gel or liquid to mask bottom 13 and wall faces 12 of the gas flow groove 7 at step S4. At step S5, the hydrophilic coating 14, other than on the bottom 13 and wall faces 12, is removed by blasting, for example, with metallic oxidized metal, resin, or glass particles. Paragraph [0040]. Such a blasting process is not particularly precise (hence the need for masking) and as recognized by those of skill in the art, would be likely to remove hydrophilic coating 14 from side walls 12 beyond the upper contact surface 23. Similarly, a grinding process can also be used to remove the top face layer 23. Paragraph [0042]. The Examiner's mere speculation of a possibility of electrical and fluid contact from the MEA 20 to the side walls 12 is not supported by Miyazawa.

Miyazawa states that "[s]ince the top face 23 of the rib 11 contacting to the MEA 20 is not provided with a hydrophilic membrane 14, it is possible to avoid reductions in porosity in the section connecting the separator 4 with the electrode (3*a*, 3*b*)" and "[t]he top face 23 of the rib 11 makes contact with the anode or cathode electrode." Paragraphs [0033], [0028]. The hydrophilic membrane 14 is the same element that the Examiner relies on as being analogous to the presently claimed liquid distribution media (LDM). Yet, Miyazawa only permits contact between the electrodes 3a, 3b of the MEA 20 with the top face 23 of the rib 11 and requires removal of the hydrophilic membrane 14 where there is contact with the MEA 20. Such a configuration follows from having porous ribs 11, which provide a path for liquid to travel through the body of the porous ribs 11 to sidewalls 12 to enter the hydrophilic membrane 14. Thus, the Miyazawa reference teaches away from an electrically conductive liquid distribution media (LDM) in electrical contact with and forming an electrically conductive path between a fluid distribution layer (FDL) and an impermeable electrically conductive element, as claimed.

The Yamada reference fails to describe either 1) a wicking material that is included on an interior of a fuel cell or 2) a conductive wicking material. While Yamada describes using external wicking materials for water collection/storage, a water-recovering wick (35 of Figures 21, 23) and water-retaining wick (41 of Figure 23), such materials are only permitted to be

external to the fuel cell so that they merely touch an outer edge of the oxidizing electrode 38. *See e.g.*, Figure 1 and Col. 38, lines 6-27. Yamada provides no suggestion or reason to include the wicking materials 35, 41 in electrical contact with the active area of the fuel cell. Yamada also advises against selecting conductive materials as the wicking material to prevent short circuiting (reinforcing that the wicking materials are exterior to the active area of the fuel cell). Col. 47, lines 10-15; Col. 38, lines 8-9 and 67-68; and Col. 39, lines 21-25. There is no teaching or apparent reason provided in Yamada to use an electrically conductive wicking material between an FDL and an impermeable electroconductive element, particularly within the active area of the fuel cell (corresponding to the MEA) where the LDM forms an electrically conductive path. Moreover, since modifying Yamada in such a manner would either provide an impermissibly high resistance within the fuel cell or alternately electrically short circuit the fuel cell of Yamada, Yamada would be rendered inoperable for its intended purpose, the Examiner's proposed modification cannot support a case of *prima facie* obviousness. Col. 47, lines 10-15; Col. 38, lines 8-9 and 67-68; and Col. 39, lines 21-25. Additionally, neither of the cited references provide any apparent reason to incorporate such porous electrically conductive materials above lands in electrical contact regions to improve MEA fuel cell performance during normal operations rather than start-up alone. As such, the obviousness rejection of Claim 3 cannot be supported by the combination of Miyazawa and Yamada and should be reversed.

ii. <u>None of the Cited References Teaches or Suggests a Liquid Distribution Media Overlying Substantially All of the Major Surface of the Electrically Conductive Impermeable Element of Claim 6.</u>

The Examiner states that Miyazawa teaches a hydrophilic covering that substantially covers all the major surface of the separator (electrically conductive element). The Examiner supports this statement by estimating that at least 75% of the separator shown in Figure 2 of Miyazawa has a hydrophilic layer 14. Examiner's Answer, Section 10(C), page 12. But, since hydrophilic layer 14 is removed from contact surfaces 23 of the ribs, which are spaced at equal intervals from one another, it would seem that only 50% of the surface of Miyazawa has a hydrophilic layer 14 (alternating ribs and grooves). See also, Paragraph [0021] and [0022] "the ribs 11b of the cathode separator 4b are disposed at equal intervals in the same manner as the ribs 11a." Secondly, Figure 2 is a schematic drawing, which is a diagrammatic representation of the device and does not necessarily represent accurate dimensions. Further, pursuant to 37 C.F.R.

§1.84(k), patent drawings are not required to indicate scale (it is generally prohibited) nor are figures necessarily reproduced to scale. Third, Appellants have provided support for the term "substantially all of a major surface" in Appellants' specification at Paragraphs [0027], [0043], and Figures 1 and 2. For example, in Appellants' specification at Paragraph [0043] at Page 21, lines 19-21, the LDM covers substantially all of the major surface 84 of the electroconductive element 70 corresponding to the electrically active area of MEA 60. Further, the advantages of such a configuration are set forth for example at Paragraph [0043], where any water potentially collecting over the lands is more evenly distributed and even humidification of the MEA is provided to diminish potential polymer electrolyte membrane (PEM) starvation and to improve operational efficiency. Page 21, line 18 bridging page 22, line 19. None of the cited references objectively describe the invention recited in Claim 6. There is no apparent reason in either Miyazawa or Yamada to arrive at the subject matter and Applicants request reversal of the Examiner's rejection.

iii. <u>None of the Cited References Teaches or Suggests a Liquid Distribution Media Forming an Undulated Surface of Lands and Grooves as Recited in Claim 8</u>.

In addition to the reasons set forth previously in the Appeal Brief and above for Claim 1, Claim 8 is further patentable over the cited art because it provides a liquid distribution media having an undulated configuration of peaks and valley, where the peaks correspond to lands and the valleys correspond to grooves to form flow channels of reactants to the electrochemical cell. The Examiner states that even though Miyazawa specifies that the hydrophilic layer 14 (allegedly the LDM) is removed from the top faces 23 of the ribs 11 (*i.e.,* the lands) and only remains on the grooves 7 (wall 12 and bottom faces 13), Miyazawa still provides a LDM having an undulated configuration of peaks and valleys, where the peaks are lands and the grooves are flow channels. However, an objective reading of the Miyazawa reference (*see e.g.*, Figure 2) provides a separator element 4 where the hydrophilic layer 14 is not provided on the top face 23 of the ribs 11, but merely on the side walls 12 and bottom 13 (grooves 7 only) and thus, does not form a land. As such, Miyazawa does not fairly provide the teachings necessary to render Claim 8 obvious. Yamada teaches away from an electrically conductive wicking material, which would be required if such a material were formed into an electrically conductive land in the active fuel

cell. Hence, a *prima facie* case of obviousness has not been established for Claim 8 by either Miyazawa or Yamada, whether considered individually or when combined.

iv. <u>The Cited References Fail to Support the Rejection of Claim 12 Having a Liquid Distribution Layer Comprising Two Distinct Layers.</u>

The Examiner provides a new basis for the grounds of rejection for Claim 12. Specifically, the Examiner cites Yamada as teaching a liquid distribution layer comprising two distinct layers disposed within an active region of a fuel cell. In addition to the reasons previously set forth, Claim 12 is patentable over the cited art because none of the cited art references objectively provide the claimed configuration. As discussed previously, Yamada has an electrically insulating water-recovering wick 35 placed along an exterior of the fuel cell, which only touches an outer edge of the oxidizing electrode 38 (Figure 1). An entirely separate water-retaining wick 41 is disposed inside a water-storing receptacle.[1] Col. 38, lines 6-27, Nos. 35 and 41 of Figures 21, 23. The water-recovering wick occupies one portion of the external water-transport channel 35 and the water-retaining wick is disposed within the water storage receptacle 41 to retain water. The water-retaining wick 41 is provided in series with the water-recovering wick 35, but there is simply no suggestion or disclosure of multi-layer porous material. Yamada fails to suggest bifurcating porous layers into a plurality of layers, which transport both liquids and gases, as claimed. Moreover, Claim 12 requires the first layer of the LDM to be in contact with the impermeable electrically conductive element and the second layer to be in contact with the fluid distribution layer. As described above, Yamada warns against using an electrically conductive wicking material, nonetheless such a material is disposed between the elements of Claim 12 to provide electrical contact with the active region of the fuel cell. Col. 47, lines 10-15; Col. 38, lines 8-9 and 67-68; and Col. 39, lines 21-25. As such, this rejection is wholly unsupported and Claim 12 is not obvious in view of Yamada or Miyazawa.

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[1] The Non-Final Office Action dated March 13, 2006 on Page 4, line 20 bridging page 5, line 7 misinterprets certain teachings of Yamada in particular to applicability of descriptions of porosity and conductivity of certain materials. See Col. 16, lines 25-40 of Yamada which describes porosity of the separator element, not of a liquid distribution (wicking) element. Col. 24: 14-20 relates to porosity of the electrodes (which must be porous, because it is a liquid fuel cell). The nickel mesh is similarly for an electrode or connector and has no applicability to wicking materials.

v. The Additional Grounds of Rejection and Arguments in the Examiner's Answer Fail to Establish a *Prima Facie* Case of Obviousness for Claims 1-3, 5-12, and 15-23.

In sum, the underlying basis for the rejections of Claims 1-3, 5-12, and 15-23 rests upon the teachings of the Miyazawa reference in view of the Yamada reference. A proper obviousness analysis requires assessment of the scope and content of each reference in its entirety, compared with differences to the claimed invention as assessed by one of skill in the art. Yet, in the present application, a *prima facie* case of obviousness has not been properly established.

For obviousness, there must be some apparent reason to make the proposed modification, as well as an expectation of a reasonable likelihood of success. Neither of these elements can be present when the art teaches that the proposed modification will create an inoperable device. It is well-settled that teaching away is the antithesis of obviousness. Furthermore, the teachings of the prior art references cannot be selectively ignored, as suggested here by the Examiner. The Miyazawa reference fails to render the claimed invention obvious and cannot be combined with the Yamada reference to support such a rejection, when Yamada teaches away from the instant invention. For the reasons set forth above and in Appellants' Appeal Brief, a *prima facie* case of obviousness has not been established for independent Claim 1, because Miyazawa and Yamada do not provide the necessary suggestion or motivation for combination to arrive at the claimed invention. Accordingly, the Examiner's final rejections of Claims 1-3, 5-12, and 15-23 should be reversed.

C. Claim 22 is Not Rendered Obvious by the Combination of Miyazawa, Yamada and Davis.

Claim 22 depends upon Claim 1. For the reasons set forth above in the context of Claim 1 and in the Appeal Brief, Claim 22 is not rendered obvious by either Miyazawa and/or Yamada. The Davis reference fails to account for the deficiencies of these references and accordingly, Claim 22 should also be allowed.

VIII. Conclusion

The present claims are patentable over the cited art.

As discussed above, the Examiner has not met the burden necessary under applicable law to demonstrate that the claims are rendered obvious over the cited art.

Appellants, therefore, respectfully ask this Honorable Board to reverse the final rejections of the claims on each ground and to indicate that all claims are allowable.

Dated: September 11, 2007

Respectfully submitted,

By Jennifer Woodside Wojtala

Jennifer M. Woodside Wojtala
Registration No.: 50,721

HARNESS, DICKEY & PIERCE, P.L.C.
P.O. Box 828
Bloomfield Hills, Michigan 48303
(248) 641-1258

Attorney for Appellants

Correspondence Address:
Kathryn A. Marra
General Motors Corporation
Legal Staff - Mail Code 482-C23-B21
PO Box 300 - 300 Renaissance Center
Detroit, Michigan 48265-3000
(313)665-4708

AMB/JMW

CLAIMS APPENDIX

Claims Involved in the Appeal of Application Serial No. 10/780,025

1. An electrochemical cell having a membrane electrode assembly (MEA) comprising an anode and a cathode, the cell comprising:

an electroconductive element comprising an impermeable electrically conductive element having a major surface facing the cathode, and an electrically conductive porous liquid distribution media disposed along said major surface defining flow channels at said major surface for transporting gas and liquid to and from the cathode;

an electrically conductive fluid distribution layer disposed between said liquid distribution media and the cathode for transporting gases and liquids between the cathode and said flow channels; said fluid distribution layer and liquid distribution media constructed and arranged to transport liquids accumulating within the cathode through said fluid distribution layer and to and through said liquid distribution media, wherein said fluid distribution layer is porous and has an average pore size larger than an average pore size of said porous liquid distribution media.

2. The electrochemical cell of claim 1, wherein said impermeable electrically conductive element and said liquid distribution media are arranged together to define said flow channels.

3. The electrochemical cell of claim 1, wherein said liquid distribution media forms an electrically conductive path between said impermeable electrically conductive element and said conductive fluid distribution layer.

4. (cancelled).

5. The electrochemical cell of claim 1, wherein said liquid distribution media is more hydrophilic than said fluid distribution layer.

6. The electrochemical cell of claim 1, wherein said liquid distribution media overlies substantially all of said major surface.

7. The electrochemical cell of claim 1, wherein said liquid distribution media is disposed in regions along said major surface defining separate spaced-apart flow channels at each of said respective regions.

8. The electrochemical cell of claim 1, wherein said liquid distribution media has an undulated configuration of peaks and valleys, wherein said peaks correspond to lands and said valleys correspond to grooves which constitute said flow channels.

9. The electrochemical cell of claim 1, wherein said porous liquid distribution media has an average pore size in the range of from about 0.2 to about 30 microns.

10. The electrochemical cell of claim 1, wherein said liquid distribution media internally re-distributes liquid water thereby minimizing differences in humidity along a face of the MEA.

11. The electrochemical cell of claim 1, wherein said electroconductive element comprises a second impermeable electrically conductive element having a second surface facing the anode and a second liquid distribution media that is attached along regions of said second surface, and a second fluid distribution layer is disposed between said electroconductive element and the anode, wherein said second liquid distribution media contacts said second fluid distribution layer.

12. The electrochemical cell of claim 1, wherein said liquid distribution media comprises a first and a second layer wherein said first layer is in contact with said impermeable electrically conductive element and said second layer is in contact with said fluid distribution layer wherein said second layer is more hydrophilic than said first layer.

13. (withdrawn) The electrochemical cell of claim 1, wherein said liquid distribution media comprises a first and a second layer wherein said first layer is in contact with said impermeable electrically conductive element and said second layer is in contact with said fluid distribution layer wherein said first layer has a larger average pore size than said second layer, such that liquid is transported at a higher rate in said first layer than in said second layer.

14. (withdrawn) The electrochemical cell of claim 1, wherein said liquid distribution media has a first surface and a second surface, said first surface is in contact with the fluid distribution layer and has an undulating surface that corresponds to said flow channels, wherein said second surface is opposite to said first surface and meets with a surface of said impermeable electrically conductive element and is planar.

15. The electrochemical cell of claim 1, wherein said liquid distribution media is electrically conductive and selected from the group consisting of: mesh, screen, and foam.

16. The electrochemical cell of claim 1, wherein said liquid distribution media is constructed of material selected from the group consisting of: carbon, graphite, polymers, stainless steel, chrome and alloys and mixtures thereof.

17. The electrochemical cell of claim 1, wherein said liquid distribution media is formed of materials that are cast, coated, or sprayed onto said major surface.

18. The electrochemical cell of claim 1, wherein said liquid distribution media comprises a conductive polymer or a non-conductive polymer with conductive particles distributed therein.

19. The electrochemical cell of claim 18, wherein said liquid distribution media is cured by application of heat.

20. The electrochemical cell of claim 1, wherein said liquid distribution media comprises a plurality of conductive metal particles selected from the group consisting of: stainless steel, niobium, nickel-chromium-iron alloy inconel, and mixtures thereof.

21. The electrochemical cell of claim 20, wherein said liquid distribution media is formed by sintering said plurality of conductive metal particles by application of heat.

22. The electrochemical cell of claim 1, wherein said impermeable electrically conductive element comprises a compound selected from the group consisting of: aluminum, titanium, stainless steel, and alloys and mixtures thereof.

23. The electrochemical cell of claim 1, wherein said liquid distribution media is formed by etching said major surface.

24. (withdrawn) An electroconductive element for an electrochemical fuel cell, said element comprising:

an impermeable electrically conductive element having a major surface;

a conductive porous layer on said element along said major surface, said porous layer being hydrophilic and operable to transport water from regions having a higher liquid concentration to regions having a lower liquid concentration within said layer, where said porous layer has a first surface and a second surface, said first surface has an undulating surface that corresponds to flow channels, and said second surface is opposite to said first surface and meets with said major surface of said impermeable electrically conductive element and is planar.

25. (withdrawn) The electroconductive element according to claim 24, wherein said porous hydrophilic layer is in contact with a fluid distribution layer which is further in contact and fluid communication with an electrode, and said porous hydrophilic layer is more hydrophilic than either of said electrode or said fluid distribution layer, whereby said porous hydrophilic layer draws water from said electrode through said fluid distribution layer.

26. (withdrawn) The electroconductive element according to claim 25, wherein said electrode is a cathode.

27. (withdrawn) The electroconductive element of claim 25, wherein said porous layer forms an electrically conductive path between said impermeable electrically conductive element and said fluid distribution layer which is electrically conductive.

28. (withdrawn) The electroconductive element of claim 24, wherein said impermeable electrically conductive element and said porous layer are arranged together to define gas flow channels.

29. (withdrawn) The electroconductive element of claim 28, wherein said first undulated surface of said porous layer has an undulated configuration of peaks and valleys, wherein said peaks correspond to lands and said valleys correspond to grooves which constitute said flow channels.

30. (cancelled).

31. (withdrawn) The electroconductive element of claim 24, wherein said porous layer has an average pore size in the range of from about 2 to about 30 microns.

32. (withdrawn) The electroconductive element of claim 25, wherein said porous layer comprises a first and a second layer wherein said first layer is in contact with said impermeable electrically conductive element and said second layer is in contact with said fluid distribution layer wherein said second layer is relatively more hydrophilic than said first layer.

33. (withdrawn) The electroconductive element of claim 25, wherein said porous layer comprises a first and a second layer wherein said first layer is in contact with said impermeable electrically conductive element and said second layer is in contact with said fluid distribution layer wherein said first layer has a larger average pore size than said second layer, such that liquid is transported at a higher rate in said first layer than in said second layer.

34. (withdrawn) A method for making an electroconductive element for an electrochemical fuel cell, comprising:

providing an impermeable electrically conductive element having a major surface;

applying a precursor of a liquid distribution media to said major surface; and

treating said precursor to form a hydrophilic liquid distribution media that is adhered to said major surface.

35. (withdrawn) The method of making an electroconductive element according to claim 34, wherein said precursor is a metallic material selected from the group consisting of: screen, mesh, and foam.

36. (withdrawn) The method of making an electroconductive element according to claim 34, wherein said treating comprises diffusion bonding said precursor to said major surface of said impermeable electrically conductive element.

37. (withdrawn) The method of making an electroconductive element according to claim 34, wherein said precursor of said liquid distribution media comprises a plurality of metal particles and a binder.

38. (withdrawn) The method of making an electroconductive element according to claim 37, wherein said treating comprises applying heat to volatilize said binder and sinter said plurality of metal particles to one another.

39. (withdrawn) The method of making an electroconductive element according to claim 34, wherein said precursor of said liquid distribution media comprises a polymer.

40. (withdrawn) The method of making an electroconductive element according to claim 39, wherein said applying comprises spray coating said precursor comprising said polymer on said major surface.

41. (withdrawn) The method of making an electroconductive element according to claim 39, wherein said treating comprises applying heat to cure said polymer.

42. (withdrawn) The method of making an electroconductive element according to claim 39, wherein said precursor of said liquid distribution media further comprises a plurality of conductive particles and pore-forming constituents.

43. (withdrawn) The method of making an electroconductive element according to claim 42, wherein said treating comprises applying heat at a temperature such that said pore-forming constituent volatilizes.

44. (withdrawn) The method of making an electroconductive element according to claim 43, wherein said treating further comprises dissolving said pore-forming constituent after said applying heat.

45. (withdrawn) The method of making an electroconductive element according to claim 34, wherein said applying comprises attaching a screen to said major surface.

46. (withdrawn) The method of making an electroconductive element according to claim 45, wherein said attaching is selected from the group consisting of: diffusion bonding, brazing, and mixtures thereof.

47. (withdrawn) The method of making an electroconductive element according to claim 34, wherein said treating comprises etching said liquid diffusion media surface to enhance hydrophilicity.

48. (withdrawn) The method of making an electroconductive element according to claim 34, wherein said treating comprises firing said liquid diffusion media surface to enhance hydrophilicity.

49. (withdrawn) The method of making an electroconductive element according to claim 34, wherein said treating comprises chemical vapor deposition onto said liquid diffusion media surface to enhance hydrophilicity.

50. (withdrawn) A method for distributing water within an electrochemical fuel cell comprising:

introducing reactant gases to a respective anode and cathode of a membrane electrode assembly (MEA);

conducting an electrochemical reaction in said MEA thereby

generating water on said cathode side;

transporting water away from said cathode by uptake of water in a

porous fluid distribution layer in contact with said cathode;

transferring said transported water to a porous liquid distribution media contacting said fluid distribution layer, wherein said fluid distribution layer has an average pore size that is larger than an average pore size of said porous liquid distribution media; and

distributing said transferred water within said liquid distribution media from areas having a higher liquid concentration to areas having a lower liquid concentration within said liquid distribution media.

EVIDENCE APPENDIX

Evidence Pursuant to §§ 1.130, 1.131, or 1.132 or Entered by or Relied Upon by the Examiner being Submitted in the Appeal of Application Serial No. 10/780,025.

NONE

RELATED PROCEEDINGS APPENDIX

Proceedings Related to the Appeal of Application Serial No. 10/780,025.

NONE